REMARKS

Summary of the Official Action

Claims 1-2 and 15 are rejected under 35 U.S.C.§102 (b) as anticipated by U.S. Patent No. 5,997,805 ("LAWCOCK").

The Office Action states that LAWCOCK discloses the metal powder as claimed. The Office Action alleges that although LAWCOCK does not teach that its powder composition is for use in selective laser sintering, the intended use of the claimed powder does not lend patentability to the composition.

Applicants note with appreciation the indication that claims 3-14 would be allowable if rewritten to include all of the limitations of the base claim and any intervening claims.

Drawings

Applicants note that the Office Action has not indicated whether the drawings are acceptable. Accordingly, Applicants respectfully request the indication of acceptability of the drawings filed on February 19, 2004 in the next official communication.

Response to the rejection of claims 1-2 and 15

The rejection of claims 1-2 and 15 under 35 U.S.C. §102(b) over LAWCOCK is respectfully traversed.

Applicants respectfully submit that claims 1-2 and 15 are not anticipated by LAWCOCK.

By way of background, Applicants note that the method of making a three-dimensional object with the use of selective laser sintering is known. The target

object is obtained by repeating the following steps: a) irradiating an optical beam (a laser or other directional energy beam) on a predetermined portion of a powdery layer of metal powder to form a sintered layer; b) forming a new powdery layer on the sintered layer, and c) irradiating an optical beam on a predetermined portion of the new powdery layer to form a new sintered layer. It is ideal to obtain, by controlling the energy density of the optical beam, various states of density, i.e., from a low-density sintered state, wherein the object contains many pores, to a high density sintered state, wherein metal powder has been solidified after being substantially melted (a state in which the sintered density is almost 100%).

In this art, in order to obtain the object of having a density difference between a surface and an interior thereof by selective laser sintering, a metal powder composition having properties different from those of metal powder used for ordinary laser sintering is needed. For example, the particle diameter of the metal powder must be smaller than the thickness of a powdery layer. A smaller particle diameter can increase the packing density of the powder, increase the density of a shaped object due to an increased absorptivity of the optical laser beam during sintering, and reduce surface roughness. However, too small a powder particle may cause cohesion, which in turn can reduce the packing density of the powder, hence making it difficult to apply the powder in a thin and uniform way.

In order for the shaped object to have a predetermined strength, sintered layers adjacent to each other must have a large contact area and a high

adhesion strength. Also, the presence of high protrusions on an upper surface of a laser-irradiated portion is not preferred because if such protrusions are higher than the thickness of a powdery layer that is subsequently laid thereupon, a difficulty may arise in forming the powdery layer.

Metal powder irradiated with a laser melts, partially or totally, and then becomes a sintered object upon rapid cooling and solidifying. If the molten metal powder has a high wettability, the contact area between adjacent sintered layers becomes large. If the molten metal powder has a high flowability, the protrusions on the upper surface of the laser-irradiated portion become small. Accordingly, it is desired that the molten metal powder has both a large flowability and a good wettability.

Further, because metal powder adheres to the surface of the shaped object, a good workability is desired for machining, such as cutting, to remove unnecessary metal powder to thereby expose a high-density surface. Apparently, the presence of large cracks in the outer surface should be avoided and in applications where a shaped object is used as a die or mold for injection molding that has a fluid (i.e. cooling water) passage defined therein, it is desired that the shaped object has no micro cracks in an internal structure thereof.

The present invention has been developed in consideration of the foregoing. More specifically, a metal powder composition according to the present invention preferably has a particle diameter not greater than 50 μm, which is less than the thickness of powdery layers. The metal powder composition as recited in claim 1 is characterized by containing an iron-based

powder material as a base material to obtain fundamental mechanical properties after shaping, a nickel and/or nickel alloy powder material to enhance the cutting workability or toughness, a copper and/or copper alloy powder material to enhance the flowability when melted, and a graphite powder material to reduce micro cracks. That is, the claimed metal powder composition contains at least four kinds of metal powder, i.e., iron, nickel, copper, and graphite, mixed together, and the metal powder is not an alloy powder (i.e. an alloy in powder form). The reason for this is that during low-density shaping, the alloy powder made up of the above elements is disadvantageously apt to rise largely at an upper portion thereof that has been irradiated with a laser. In addition, the claimed powder mixture contains no lubricant for the purpose of reducing fumes (metallic vapor) that is produced during shaping by laser irradiation.

Turning now to the document cited in the rejection. LAWCOCK discloses a method of making high density, high carbon, sintered powder metal steels using an iron-based powder, graphite, lubricant, and at least one alloy element selected from the group of chromium, copper, manganese, molybdenum, nickel, niobium, or vanadium. The composition is compacted in rigid dies, sintered, and during cooling an isotherm or slow cooling treatment is introduced. Because an iron-based sintered member containing a relatively large amount of carbon is high in hardness but low in ductility, secondary processing (sizing, coining, repressing) is difficult. However, the high carbon, sintered powder metal steels as disclosed in LAWCOCK are appropriately selected in its material composition and are isotherms or slow-cooling treated during cooling. Hence, they have

mechanical properties enabling the secondary processing. Because iron-based powder mixed with graphite is likely to increase the hardness and to cause damage to a molding die, graphite is separately contained to avoid mixing with the iron-based powder.

The metal powder composition according to the present invention employs mixed powder of iron powder, nickel powder, and copper powder for rapid-heating and rapid-cooling shaping by a laser. In contrast, LAWCOCK discloses a mixture of a powder material such as graphite, nickel or copper with an iron-based powder, or a powder material, which has been alloyed in advance, is compacted, sintered within a furnace, and isotherm or slow-cooling treated during cooling. Therefore, the metal powder composition is different from what was disclosed in LAWCOCK.

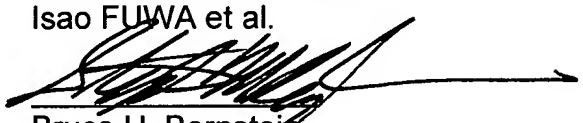
Furthermore, the metal powder composition according to the present invention contains no lubricant, whereas the composition of LAWCOCK contains lubricant for enhancing the workability and holding the shape after the shaping. In addition, as for the inclusion of graphite powder, the present invention is directed to a reduction in micro cracks after the shaping, whereas LAWCOCK appears to be directed to reduce wear of a molding die.

In summary, the presently claimed invention differs from LAWCOCK in the field of art, objectives, and effects and is not anticipated or suggested by LAWCOCK. Therefore, the rejection should be withdrawn.

CONCLUSION

In view of the foregoing, it is believed that all of the claims in this application are in condition for allowance, which action is respectfully requested. If any issues yet remain which can be resolved by a telephone conference, the Examiner is respectfully invited to telephone the undersigned at the telephone number below.

Respectfully Submitted,
Isao FUWA et al.



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